

# DELTA WING GLIDER

## Objective

The students will:

Learn how to change the flight characteristics of a glider.

Conduct an experiment to answer a question.

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## Standards and Skills

### Science

Science as Inquiry

Physical Science

Science and Technology

### Mathematics

Measurement

Problem Solving

### Science Process Skills

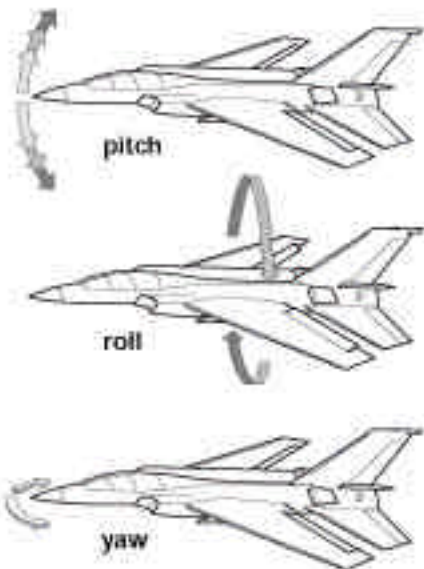
Making Models

Investigating

Predicting

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## Background

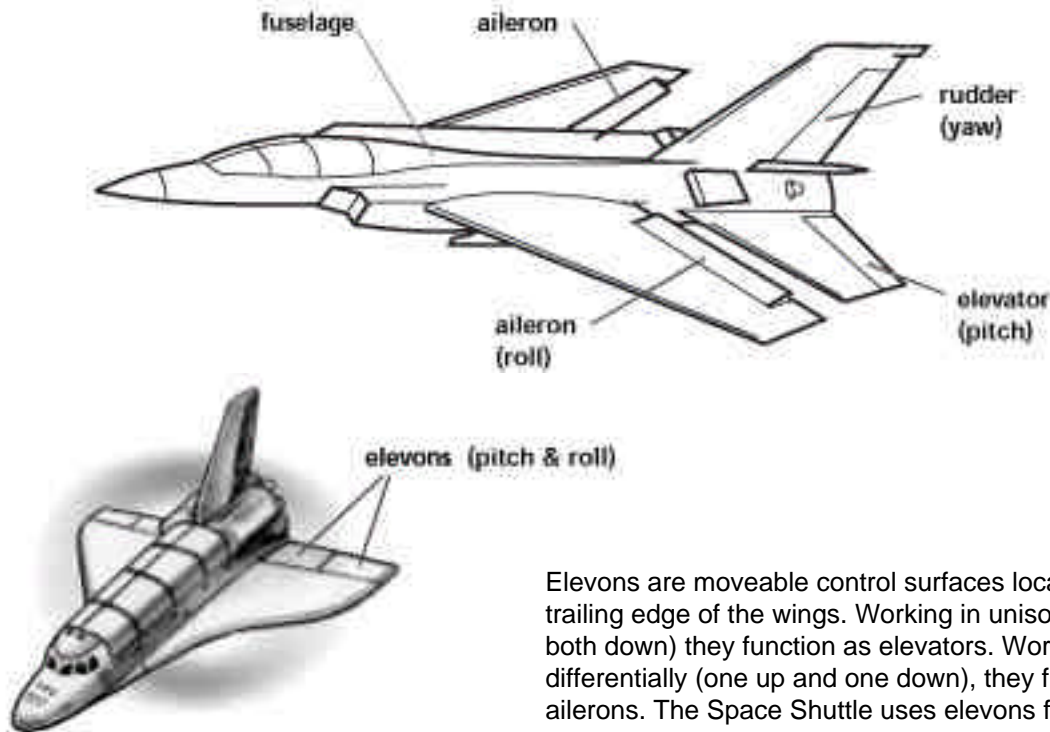


There are many types of vehicles used to transport people and objects from place to place on Earth. How are these vehicles guided to a destination? Turning the steering wheel changes a car's direction. The rudder is used to control the direction of a boat. A bicycle is controlled by turning the handle bars and shifting the rider's weight. For most land and sea vehicles, directional control is accomplished by moving the front end right or left. Movement in this one axis of rotation or direction is called *yaw*.

Flying an airplane requires control of three axes of rotation or movement. The nose of the plane can be moved right and left (*yaw*), rotated up and down (*pitch*) and the fuselage can be rolled left and right (*roll*). A pilot uses the control wheel or stick inside the airplane to move control surfaces on the wings and tail of the plane. These control surfaces turn the airplane by varying the forces of lift.

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Airplanes with conventional wings use *ailerons* to control roll, a *rudder* to control yaw, and *elevators* to control pitch. Airplanes with delta or triangular shape wings have a rudder, but only one control surface (*elevon*) to control pitch and roll. An elevon serves the same function as an *elevator* and an *aileron*.



Elevons are moveable control surfaces located on the trailing edge of the wings. Working in unison (both up or both down) they function as elevators. Working differentially (one up and one down), they function as ailerons. The Space Shuttle uses elevons for control in the air close to the Earth as it descends from space.

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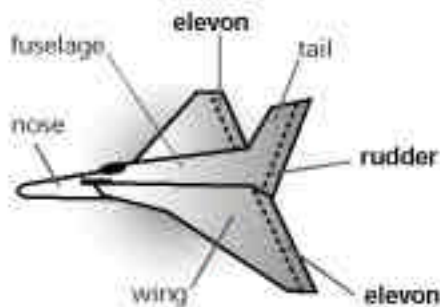
## Materials

Styrofoam food tray, about 28 cm X 23 cm (Size 12)  
Cellophane tape  
Paper clip  
Ball point pen  
Plastic knife or scissors  
Toothpicks  
Goggles (eye protection)  
Emery boards or sandpaper

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## Preparation

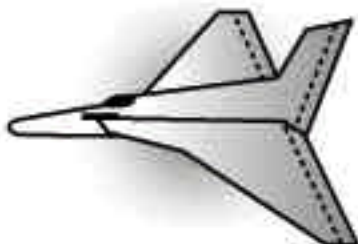
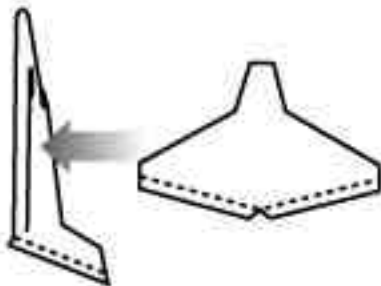
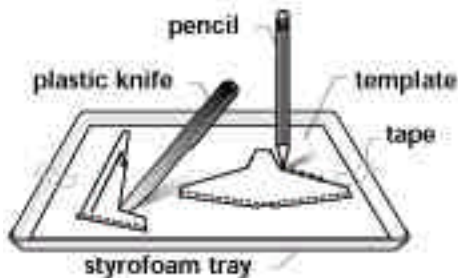
1. Show the class a Styrofoam food tray and ask them to identify it. Ask the students to list other uses for Styrofoam. Responses may include cups, fast food containers, egg cartons, packaging material, and insulation.
2. Discuss with the students some reasons for using Styrofoam in the construction of a model glider. Materials for building airplanes must be lightweight, strong, and readily available.



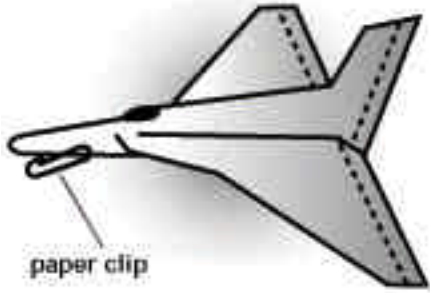
These qualities make Styrofoam a good material for the construction of flying models. Real airplanes are made from another lightweight, strong, and readily available material called aluminum.

3. Styrofoam can be cut using scissors or a serrated plastic knife. Students can also use a sharp pencil or round toothpick to punch a series of holes approximately 2 mm apart around the outside edge of the part. The part can then be pushed out from the tray. Pre-cut the Styrofoam parts for younger students.
4. Provide the student with a word list for parts of the glider. *Fuselage (body of the glider), wing (provides lift), rudder (yaw control), elevons (roll and pitch control).*

## Activity



1. A student page contains a template used to cut out the Styrofoam parts of the glider, and instructions for assembling the parts. Educators of K-2 students may want to cut out the gliders ahead of time.
2. Ask the student to write the name of each airplane part on the template.
3. Tape the glider template to the Styrofoam meat tray.
4. Use a sharpened pencil or toothpick to punch holes around the outline of the wing and fuselage. Make sure the hole goes through the Styrofoam.
5. Remove the template and trace around the outline of the wing and fuselage on the tray using a pencil or toothpick. Punch out each part.
6. Smooth the edges of each part using sandpaper or an emery board.
7. Mark both elevon hinges with a pencil. (Note: to make the elevons hinge up and down, use a pen to lightly score the hinge line on the Styrofoam wing. If a break occurs at the hinge line, use clear tape to repair the break.)
8. Carefully cut a slot in the fuselage and slide the wing into it. fuselage



9. After constructing the glider, the students determine the "weight and balance" by attaching a paper clip or binder clip to the fuselage. Students should vary the position of the clip with each flight until the glider flies the greatest distance in a straight line.
10. The flight test questions found on the Student Page can be answered by conducting flight experiments. The students change the position of the elevons and draw a diagram to record the flight path of the glider. Test fly the glider and record the results.

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### Discussion

1. Do all gliders fly alike? *No. Small differences in construction can change the flight characteristics of a model glider.*
2. Why do we predict what will happen before a test? *Predictions help scientists decide what questions the experiment will answer.*

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### Extensions

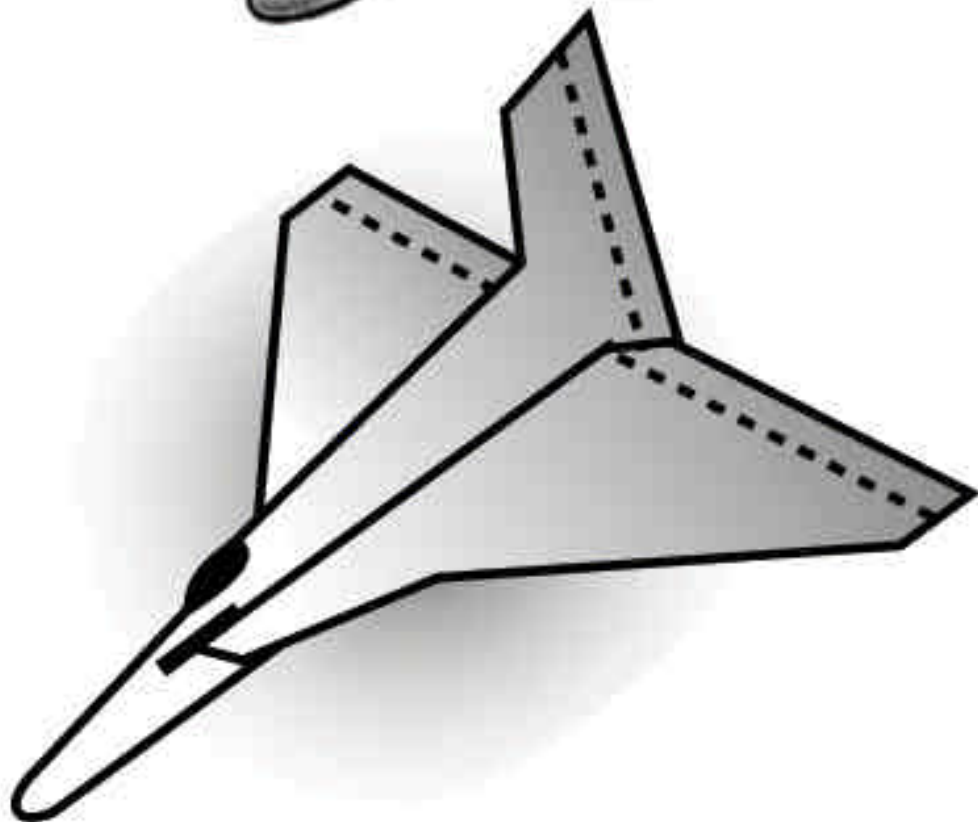
1. Have students measure and record the distance of the longest flight.
2. Have the students change the size or shape of the wing. Test fly the redesigned glider and record any changes in the flight characteristics.

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### Assessment

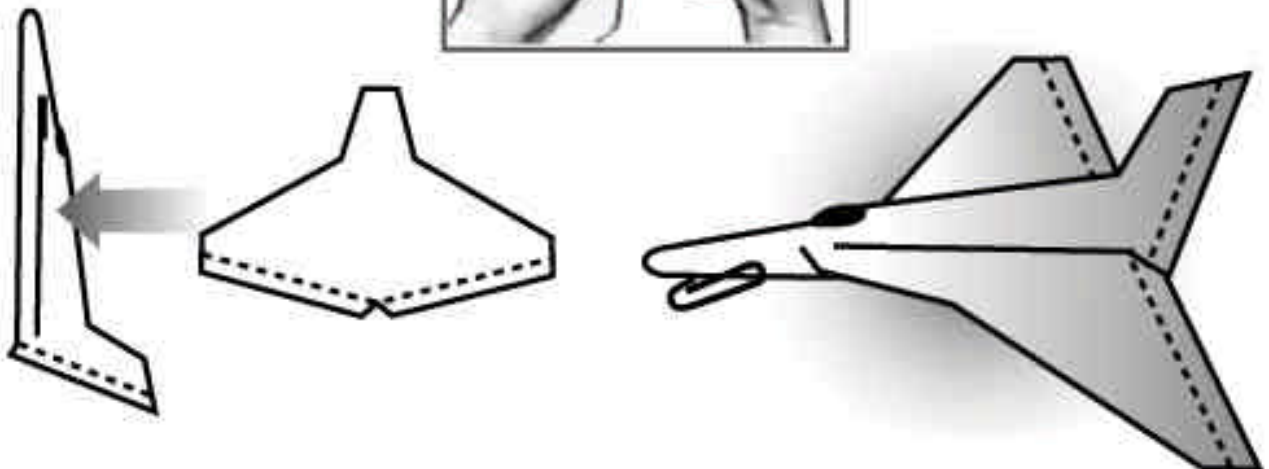
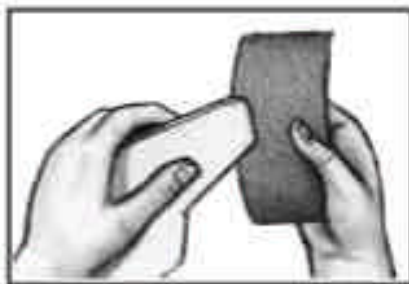
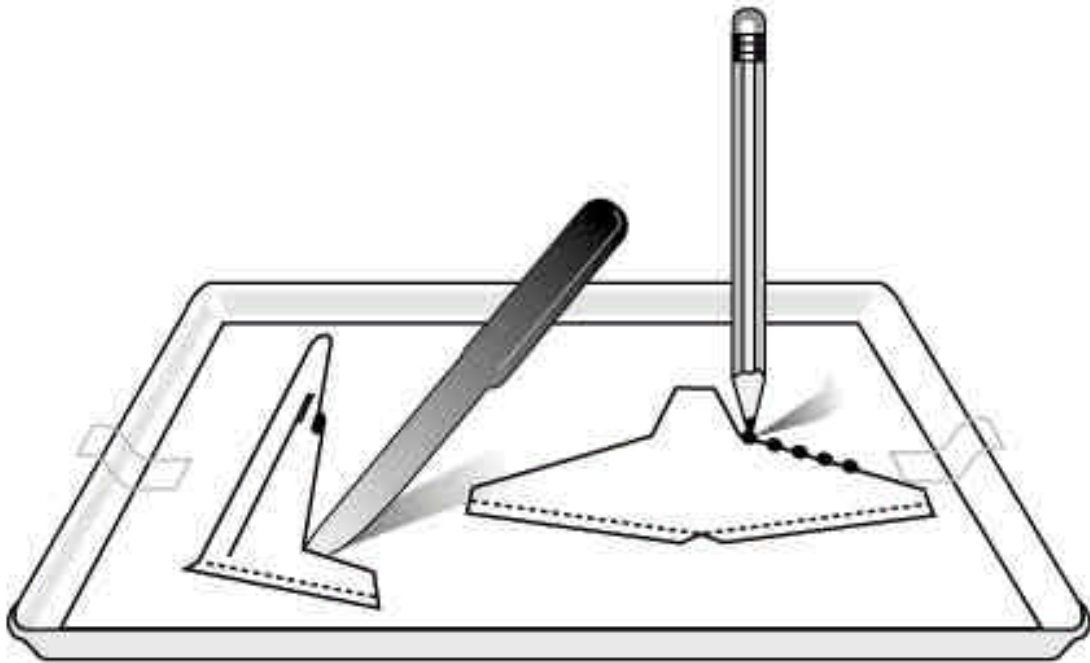
1. Bend the control surfaces on a model glider and ask the students to predict what flight path it will follow. Students can walk the predicted flight path, and launch a glider to test the prediction.
2. Group students together and have them submit a Team Student Record Sheet that summarizes the experimental flight test results.

# Delta Wing Glider

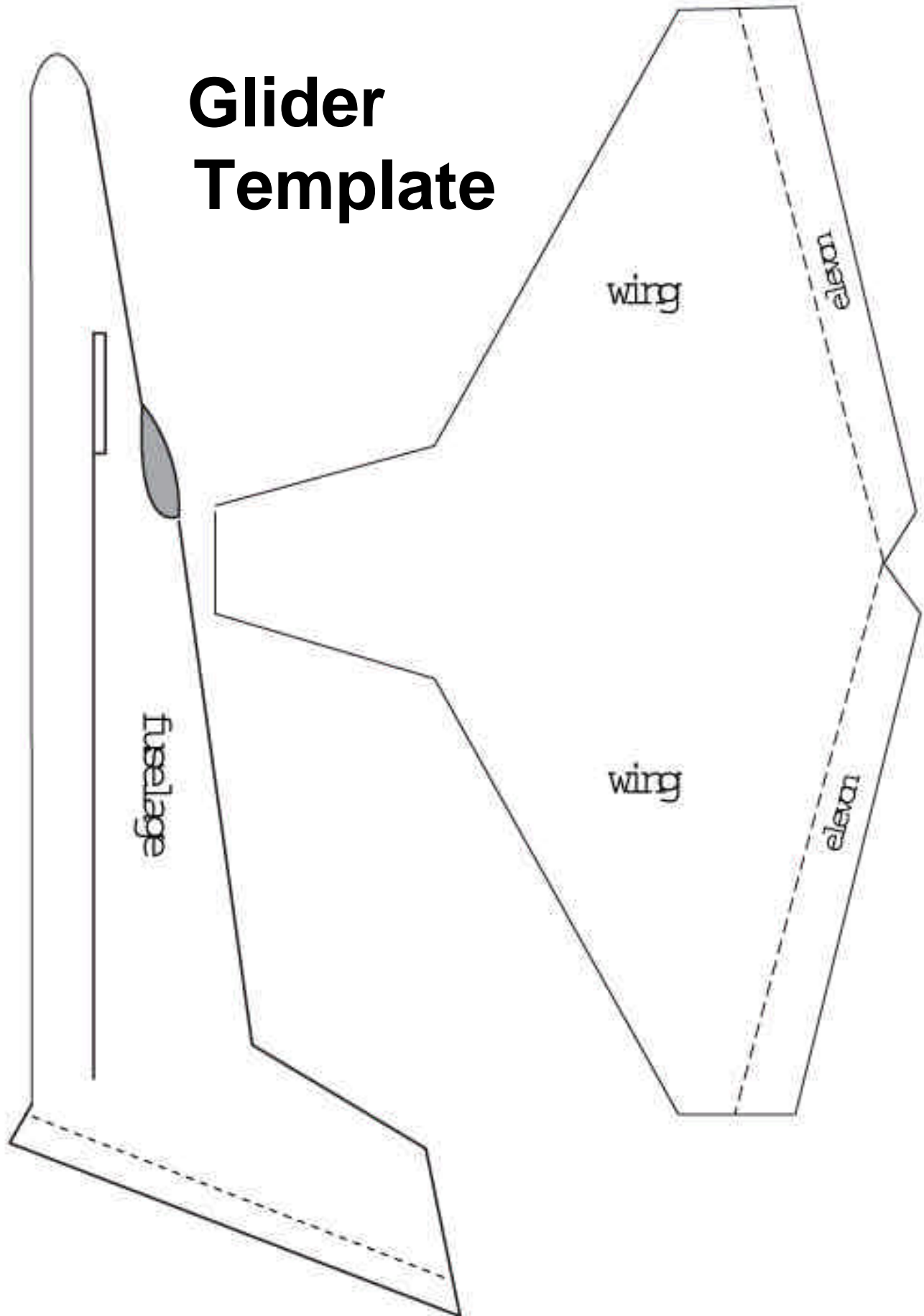




# Delta Wing Glider



# Glider Template



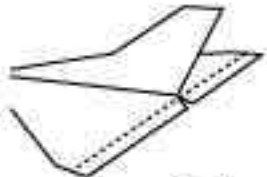
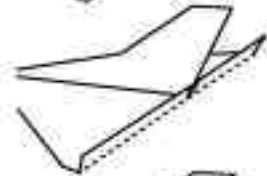
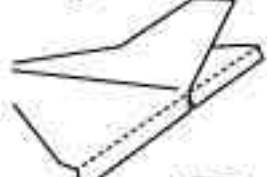

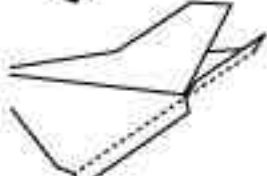




**Test Question:** Does changing the position of the elevons on a delta wing glider change its flight path?

**Directions:** Bend the elevons into the positions listed below. Be sure to predict the flight path before flying the glider. Test fly the glider and record the results (up, down, left, right).

### Student Test Pilot Record Sheet (What I Observed)

Position of elevons		Predicted Flight Path	<i>Path of Test Flight</i>
Right and left straight		_____	_____
Right and left up		_____	_____
Right and left down		_____	_____
Right down, left up		_____	_____
Right up, left down		_____	_____

Does moving the elevons change the way the glider flies?

What happens when both elevons are in the up position?

What happens when both elevons are in the down position?

Does changing the position of elevons on a delta wing glider change its flight path?

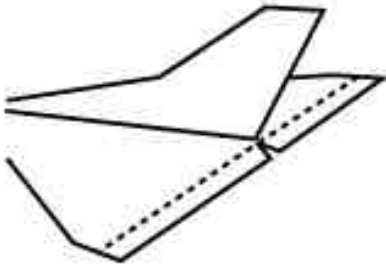




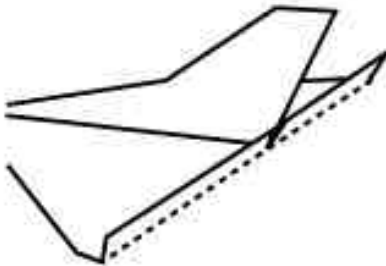
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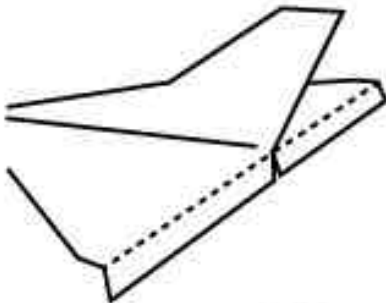
Draw the flight path



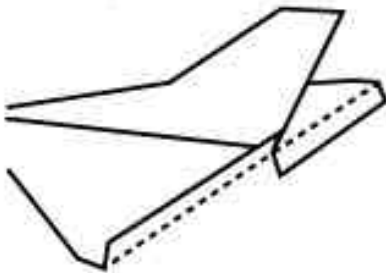
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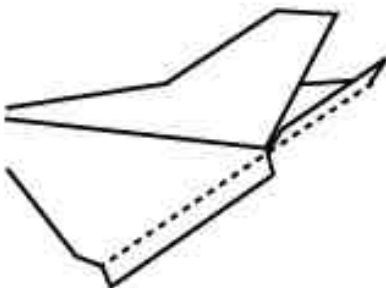
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